CS-308-2014 Final Report

DATALOGGER AND ANALYTICS

TH-06

Manideep(100050069), Girraj(100050030)
Venkatesh(100050081), Akshay(100050022)

Table of Contents

1. Introduction

A greenhouse is a building in which plants are grown. These structures range in size from small sheds to industrial-sized buildings. Greenhouses are used extensively by botanists, commercial plant growers, and dedicated gardeners. Particularly in cool climates, greenhouses are useful for growing and propagating plants because they both allow sunlight to enter and prevent heat from escaping. The transparent covering of the greenhouse allows visible light to enter unhindered, where it warms the interior as it is absorbed by the material within. The transparent covering also prevents the heat from leaving by reacting the energy back into the interior and preventing outside winds from carrying it away.

One of the major tasks is to optimize the conditions for plant development in greenhouse. The greenhouse climate factors on which optimal plant development depends are as follows:

- Light: Light is the most significant parameter for the plant development and life. All the active life process in it can be achieved only in the presence and active influence of light
- Pressure: Air pressure controls the atmospheres circulation, and there- fore influences how moisture moves.
- Temperature: Air temperature influences the energy balance of the plant canopy through the convective heat transfer to the plant leaves and bodies. Depending on the character of the air movement in the greenhouse, it is more or less near the temperature of the plant itself
- Humidity: Air humidity directly influences transpiration of the plant leaves. Lower humidity means drying of the plant and reduced production. Higher humidity produces more leaves, lower quality of fruits and sensitive to a number of plant diseases.

2. Problem Statement

- Collecting the temperature data throughout the Greenhouse crop growing region using Wi-Fi by continuously moving the bot inside the greenhouse and deploying a server in the greenhouse which can collect the data through its receiver.
- Creating a database which dynamically creates appropriate entries for various environmental parameters like temperature in the Greenhouse.
- Designing a web interface whose backend can handle the data of the multiple Greenhouses and whose frontend can display the data and the real-time graphs of the Greenhouse of user's choice.

3. Requirements

3.1 Functional Requirements

- Publish Real time Data Frontend is responsible for showing the latest values of temperature, humidity, pressure and luminosity as it is updated in database. A 3D map of temperature variations at nine different areas of the crop growing region of the greenhouse is plotted and shown on the web interface.

- Data at different altitudes Real time data of temperature is collected at different regions as many as nine and at different altitudes as many as three at each region to generate a 3D graph if the real time data.
- Real time Graphs As real time data keeps on coming continuously at interval of 3 seconds, it automatically gets updated in database and real time graphs shifts as per the latest value received. Web interface shows this dynamic graph and provides features for scaling and selecting values as required.

3.2 Non-Functional Requirements

- The bot that collects the temperature readings is FB-VI. There is a wooden base attached at the top of the bot. There is a wooden rod of length 6 feet. The purpose of the wooden base is to hold the wooden rod tightly up in the air vertically. There are four LM35 temperature reading sensors attached to the wooden rod symmetrically. The purpose of the using is four different sensors is to collect the temperature data in green house at four different places.
- ZigBee is there by default in FB-VI. LM35 sensors send temperature data at different heights to the ZigBee Wi-Fi module in the FB-VI which acts as transmitter. So to collect this data and store in the database one more ZigBee Wi-Fi module is arranged which acts as receiver and is connected to the database.
- The greenhouse has the fixed area and because of this facility the bot is coded in such a way that its motion is controlled by the total distance it has to travel and it is always fixed.

3.3 Hardware Requirements

- Firebird-VI
- LM35 Temperature Sensor
- Wooden Rod
- ZigBee

3.4 Software Requirements

- Net Beans IDE for developing web application
- Tera Term and X-CTU terminals
- Code Composer Studio 5.3.0
- MySQL server 5.1.49
- JDK 6 and Apache Tomcat Server 7.0
- Languages : Java, JSP, HTML, JavaScript, J2ME, SQL
- Libraries : MySQL connector(JDBC), RXTXcomm.jar

4. System Design

Figure1 shows the rough setup of all the equipment in the greenhouse. The nine transmitters in the crop growing area of the Greenhouse shows the nine different regions where the bot with the transmitter collects the data. The bot also collects the data at different heights. At the same region 3 different values of temperature are taken at three different heights. Figure2 shows the working of the whole process. How the frontend and backend works in coordination with the hardware. This FSM is for a typical Greenhouse. In Figure1 the RegionNo (Red labelled) is nothing but the numbers of different places in the crop growing region of the Greenhouse.

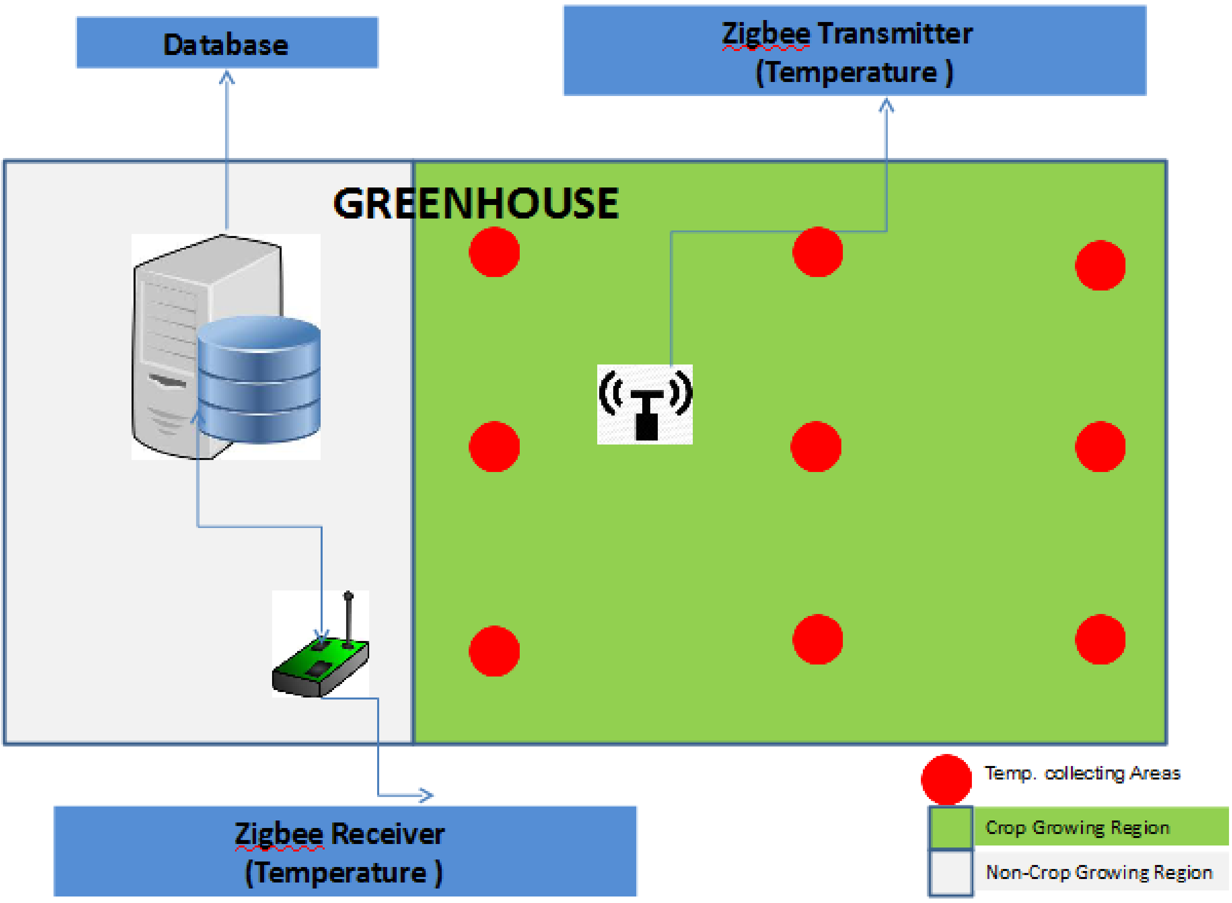

Figure 1 : Design to collect temp. in greenhouse

Figure 3 shows final design of our bot which include Firebird 6 at bottom & wooden rod fixed on it. 4 LM 35 temperature sensor circuits are placed at height of 1 feet, 3 feet, 5 feet, and 7 feet. These sensors are connected to firebird using male-female wires. There is a database connected with a zigbee receiver which will receive the temperature value from another zigbee embedded in FB-VI which acts as a tramitter of data. LM35 sensers sense the temperature value and send the values to FB-VI which interm transmits it using zigbee.

Figure 4 shows the circuit diagram of sensors. Main component of this circuits are:

- Resistor
- Capacitor
- Sensor

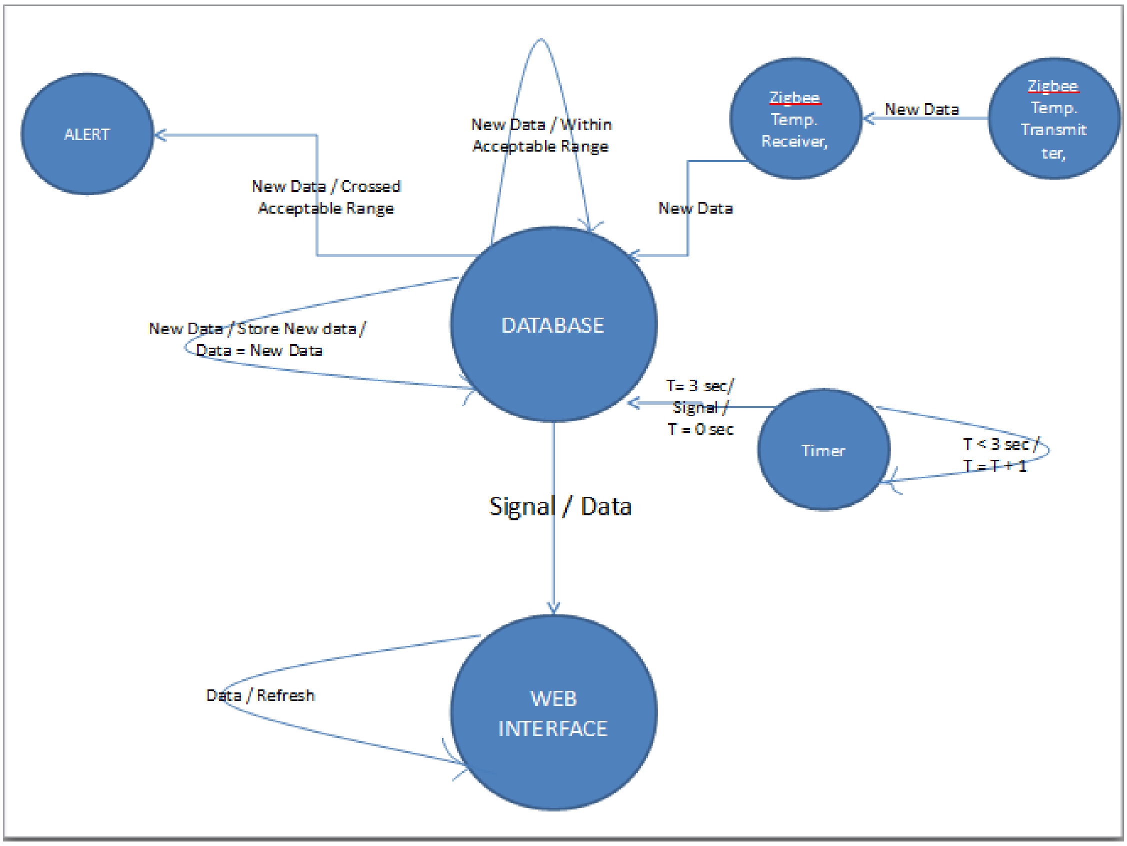

Figure 2 : FSM of the algorithm used for implementation

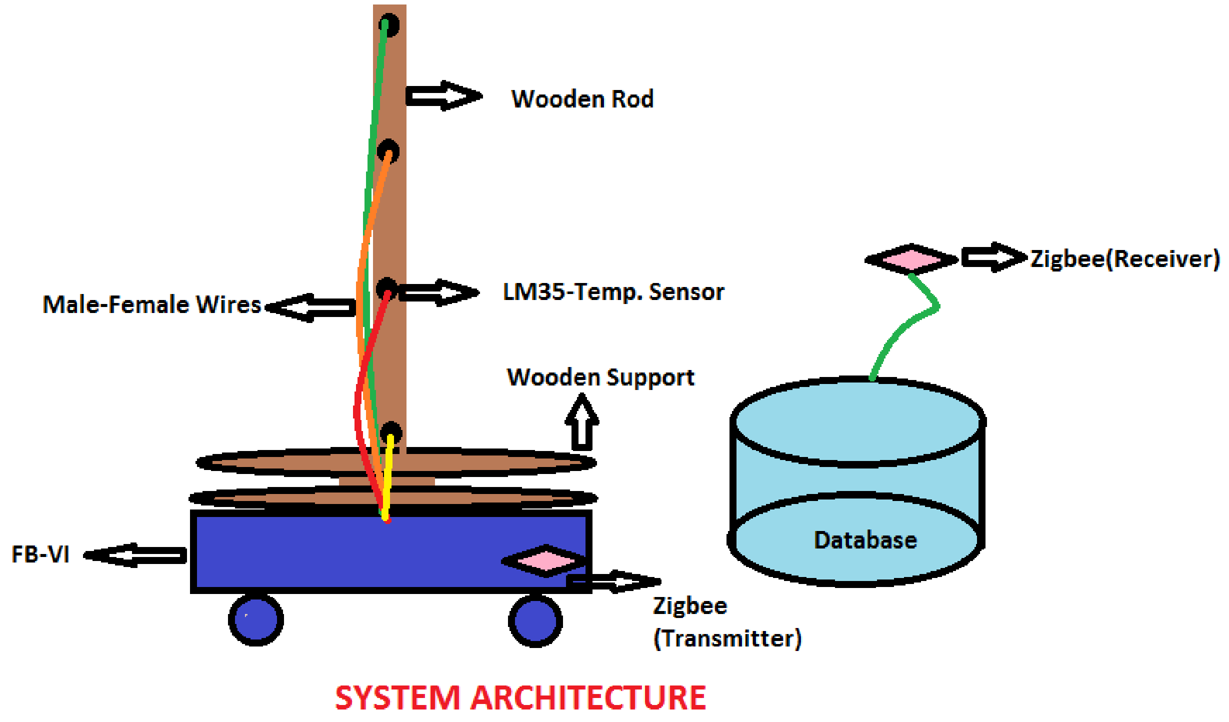

Figure 3 : System Architecture

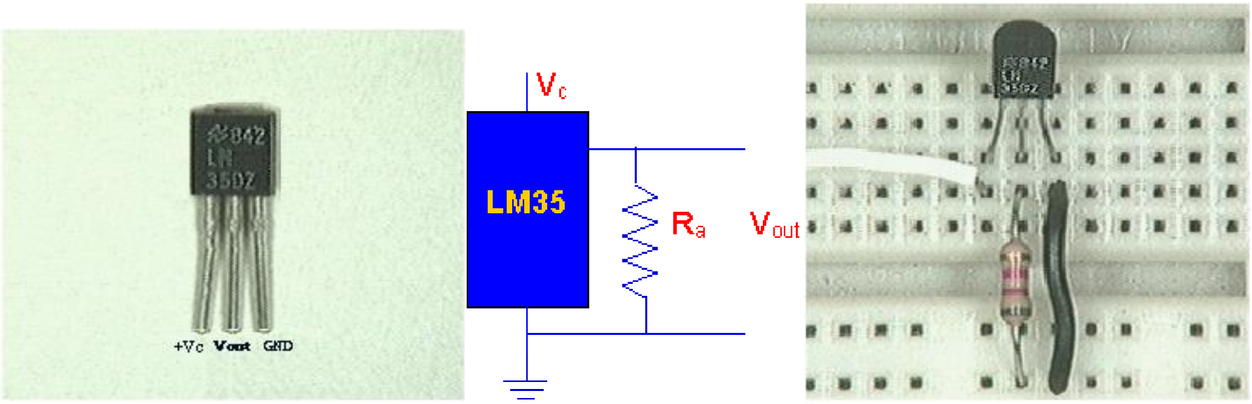

Figure 4. a) LM 35 b) Electrical Connections c) LM 35 wired on a circuit board.

5. Working of the System and Test results

In our green house, plants are of around 5-6 feet height. Temperature level will be low near ground due to watering & lesser exposer to sun light. It will gradually increase with height. Above 6 feet, it is open to environment so we can expect even higher temperature. Our sensors are at 1 feet, 3 feet, 5 feet and 7 feet so we can get good idea of temperatures at different level. Expected temperature difference between top most sensor & bottom one is 2 - 3 ^{o}C. We can interpolate these values to get curve between temperature & height. These values of sensor will be sent to server using ZigBee which are saved in a database & also used to plot real time graph.

Testing:

We tested our system in Kresit Lab as we needed open space. Here also we got temperature variation with height.

Following are the results:

Serial No.	1 feet	3 feet	5 feet	7 feet
Reading 1	24.984	25.132	25.150	26.012
Reading 2	24.962	25.023	25.165	25.356
Reading 3	24.993	25.167	25.103	26.185
Reading 4	24.921	25.145	24.953	26.420
Reading 5	24.932	25.562	25.357	26.134

6. Discussion of System

a) What all components of your project worked as per plan?

Things done as per plan:

- Data at different altitudes: Real time data of temperature is collected at different regions as many as nine and at different altitudes as many as three at each region & saved to database.
- Real time Graphs: As real time data keeps on coming continuously at interval of 3 seconds, it automatically gets updated in database and real time graphs shifts as per the latest value received. Web interface shows this dynamic graph and provides features for scaling and selecting values as required.

b) What we added more than discussed in SRS?

- Nothing more has been implemented than what we stated in SRS. But modifications were done in our approach.

c) Changes made in plan from SRS:

We only took reading of temperature at various height & generated real time 3D map of temperature in greenhouse. We didn’t implemented SMS/Email part & Supportability part of project.

Reason: After first presentation, Kavi sir told us to do only 3D real time mapping of temperature part. Other part doesn’t matter.

7. Future Work

- Sending a SMS/email base alert to the supervisor, if temperature crosses the band limit in the Greenhouse crop growing region.
- Same procedure can be extended for other parameters like pressure, humidity & Luminosity.
- Sensor used in this project is LM 35 have 0.5°C Ensured Accuracy (at +25°C). We can use

better digital sensors with high accuracy.

- LM 35 is low cost sensor so we can use multiple sensor for different height but if we use high accuracy costly sensor then to make it cost efficient, we have to implement pulley system to move single sensor up down & get reading at different heights.
- Can be implemented an automatic monitoring Bot which can control the parameters like temperature, luminosity etc. in greenhouse.
- Automatic charging Bot can be implemented which automatically charges itself when it required to charge.

8. Conclusions

- It was an awesome experience to do the project. Lot of learning has happened during the course of the project. We really enjoyed doing project.
- There are many greenhouse parameters to work with but we selected temperature for our project and developed a system which could measure the temperature at different places and four different heights. Same procedure can be applied for other parameters in future.
- There is a lot of scope for this project in future to implement. Lot of different things can be done as mentioned in the future work.
- Even though we couldn't implement the system as we planned but we are very much satisfied with the implementation we have done, especially with the hardware part where we felt that we have done a good job.
- As far as software part is concerned we couldn't implement the 3D graph properly.

9. References

1. http://en.wikipedia.org/wiki/Greenhouse
2. http://www.facstaff.bucknell.edu/mastascu/elessonshtml/Sensors/TempLM35.html
3. http://www.ti.com/lit/ds/symlink/lm35.pdf
4. GREENHOUSE CLIMATE FACTORS by Kiril Popovski, Faculty of Technical Sciences, Bitola University, Bitola, Macedonia
5. E-yantra website http://www.e-yantra.org/home/
6. FB-VI Datasheets